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ERCB

Drilling and Completions Operations Guide

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Drilling and Completions Operations Guide

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1 INTRODUCTION

The purpose of this guide is to specify the minimum requirements of sections 3.010, 3.070, and 6.080 of the Oil and Gas Conservation Regulations as they relate to abandonment and other drilling and completion operations.

This guide

- quotes the relevant sections of the regulations;
- describes present minimum requirements for drilling and completion operations covered by sections 3.010, 3.070, and 6.080, including abandonments.

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2 REGULATIONS

The applicable sections of the Oil and Gas Conservation Regulations are quoted below.

2.1 Section 3.010(1)

"The licensee of a well shall apply for and obtain the permission of the Board before performing any of the following operations, or causing or permitting them to be performed,

(a) suspend normal drilling operations;

(b) abandon the well;

(c) plug back the well or abandon a formation in the well;

(d) remove casing from the well;

(e) resume drilling operations after a previous completion, suspension or abandonment of the well."

2.2 Section 3.070

"When a well is being abandoned, the licensee shall place a cement plug extending from a depth of at least 200 metres to surface, unless that interval is covered by casing which is cemented over the interval, but the Board may specify the depth of the plug for a specific well or area."

In addition, section 6.080(4) requires protection of usable water aquifers.

2.3 Section 6.080(4)

"Where the required surface casing setting depth is less than

(a) 180 metres, or

(b) 25 metres below any aquifer[1] which is a source of usable water[2],

the casing string next to the surface casing shall be cemented full length."

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[1] For further information regarding useable/potable aquifers contact:
Alberta Environment, Groundwater Protection Branch, Edmonton.

[2] Usable water, as defined by Alberta Environment, is water having less than 4000 mg/L total dissolved solids.

The above regulation applies during the primary cementing of all cased wells and will also be enforced when a well is abandoned. Although this regulation refers to wells in which casing is run, in principle it can also be applied to open-hole abandonments such that the licensee must place a cement plug extending 25 metres below any aquifer to surface or inside the surface casing. Where this regulation contradicts section 3.070, the deeper of the two shall apply.

3 MINIMUM REQUIREMENTS

3.1 Open-hole Abandonments and Plugbacks

- The ERCB requires licensees to set plugs of sufficient length and number to ensure isolation of zones. Representatives of the Board authorize plug intervals to isolate or cover porous zones and to cover any usable water zones. All formation tops and porous and tight intervals, including usable aquifers, must be identified when the abandonment program is requested.

- Plugs must extend a minimum of 15 metres above and below the formation or porous interval being covered; alternatively, isolation plugs must be set a minimum of 15 metres below the base of the next zone which contains porosity to a minimum of 15 metres above the top of that porous zone. Refer to Appendix II for typical abandonment schematics.

- The bottom plug traditionally run from total depth is not necessarily required provided the first suspended plug covers the deepest porous interval. The reasoning is that the open-hole logs may miss reading any porosity in the bottom 15 metres of hole; this porosity is isolated if the next porous interval is covered.

- A plug covering the surface or intermediate casing shoe is required and must be placed a minimum of 15 metres below to 15 metres above the shoe.

- The minimum plug length for any plug is 30 metres.

- It is recommended that a strap tally and tally adjustments be performed when positioning the drill pipe prior to running any abandonment plug. Alternatively, if plugs are to be logged, a collar locator may be run and be used in conjunction with the pipe tally to position the drill pipe when running subsequent plugs.

- Any plug required to be run to surface shall be topped off to surface after the pipe is pulled and again if observed to drop after topping off.

- Any plug proposed to be staged must be approved by a representative of the Board. The plug(s) to be staged, the depth of the stage(s) and the stage(s) to be located must be authorized. The break between stages in a staged plug must occur within a zone, preferably in a non-porous interval, or between potentially productive zones, but not at a zone top.

- Class "G" neat cement is the preferred cement for running abandonment plugs; however, the use of fillers and/or additives in the cement system will be acceptable if the compressive strength of the mixture is at least 3500 kilopascals after curing for 48 hours at the temperature of the uppermost hydrocarbon zone which will be plugged with the alternative cement system.

- All plugs run, including a plug run on bottom, must be located by an approved method detailed in Section 3.2 of this guide. The exceptions to this include

  (1) one stage of multi-stage plug provided there was no loss of circulation,

(2) where continuous cement is run from total depth to surface in one or more stages provided there was no loss of circulation,

(3) a plug run on bottom only if a DST has been run and less than 300 metres of fluid was recovered and no loss of circulation noted while drilling, and

(4) the top plug if it is run to surface.

- Once a plug has been located and its top found more than 7 metres low, significantly high, or misplaced, it will be considered an unacceptable plug. A significantly high plug is defined as a plug located more than 7 metres above the theoretical top of the plug calculated using the actual volume of cement run and the drill pipe setting depth, and assuming gauge hole volume. The rationale for this definition is that by using gauge hole volume, the highest theoretical top will be calculated, thus allowing for permissible errors.

- Any plug located more than 7 metres below the required minimum top as authorized by the ERCB must be built up. The built-up plug should again be located.

- Any plug located significantly high, which cannot be readily explained on review of the cement yield and volume, must be either backwashed or drilled out and subsequently rerun, since it is likely that the plug is channelled or the drill pipe was set too high. The integrity of a plug which is located significantly high may be proven by logging through the entire length of the plug.

- Any plug which is misplaced in the wellbore must be rerun unless the licensee can demonstrate that interzonal isolation has been achieved. Requests for waivers from rerunning misplaced plugs may be made to any ERCB office.

- In any case where the Board staff believe an unacceptable plug may result in interzonal communication or contamination of usable water zones, a licensee may be required to re-enter a well, drill out the unacceptable plug and reabandon the well.

- Following abandonment operations and prior to capping, the licensee must inspect the well to ensure the fluid level is static and there are no flows at surface either inside or outside the well casing.

- Surface abandonment shall consist of cutting the casing strings off a minimum of 1 metre below ground level; the surface casing shall be plugged at surface with a minimum five-sack cement plug or a steel plate welded across the surface casing. If intermediate casing is in the hole it shall be plugged at surface with a minimum five-sack cement plug and a steel plate shall be welded across the surface casing.

- When conducting open-hole abandonments or plugbacks in an oil sands area refer to Subsection 4.2 for additional requirements.

3.2 Cement Plug Location

The methods described within this section are approved methods of cement plug location. Letters of approval which were on file with the Board's Drilling and Production Department prior to 1 October 1991 are superseded by the requirements within this guide. Applications to add or modify methods of plug location within this guide should be submitted to the Drilling and Production Department.

3.2.1 Location with Drill Pipe

A strap tally (measuring and counting joints of drill pipe) and subsequent tally adjustments are recommended for determining both the drill pipe setting depth for each plug and the location of the plug top. The plug top shall not be located until after waiting a period of 8 hours from the time the plug was run, unless approval for a lesser time is granted by an ERCB representative. The minimum force with which plugs must be located is 1800 daN or string weight, whichever is less.

Where a well is abandoned, the reporting requirements for location of a plug with drill pipe are as follows, and these details must be included on the abandonment summary report of Board Form ED-21:

- cement type, mass (tonnes), and slurry volume (cubic metres) run for each plug,
- drill pipe setting depth (it is recommended that a strap tally and tally adjustments be shown on the drilling tour reports to support the reported drill pipe setting depth),
- force (decanewtons) with which the plug top was felt,
- depth of the plug top located (it is recommended that a strap tally and tally adjustments be shown on the drilling tour reports to support the reported plug top location), and
- the date and time that each plug was located.

3.2.2 Direct Density Plug Logging

This method utilizes a radioactive source and detector run on wireline. The resulting log must show fluid density, fluid gradient, or percentage cement. The requirements for direct density logging are as follows:

(a) The difference between the cement density and the density of the drilling fluid must be at least 300 kilograms per cubic metre (or 2.9 kilopascals per metre).

(b) Tool calibration must be performed at least once per job.

(c) A gamma ray or other suitable log correlatable to the open-hole log suite must be run for depth control purposes. The base gamma ray log must be traced onto the plug log and depth corrections made as necessary; alternatively, remarks regarding all gamma ray deflections which were visually correlated and any depth corrections made must be included on the plug log.

(d) A collar locator may be run and be used in conjunction with tally adjustments to determine the drill pipe setting depth for each plug. In the absence of a collar locator, strap tally and adjustments should be used as discussed in Subsections 3.1 and 3.2.1.

(e) The drill pipe must be pulled above the top of the plug prior to location with logging tool.

(f) A minimum of 25 metres of plug shall be logged to accurately determine the plug top. The plug top located shall be interpreted as a suitable intermediate point between drilling fluid and cement slurry density, commonly 1600 kilograms per cubic metre (or 15.7 kilopascals per metre).

(g) If for any reason the plug logging method fails to clearly indicate the plug top, the licensee shall locate the plug top with drill pipe as per subsection 3.2.1 above.

(h) The reporting requirements for well abandonments are detailed in Appendix I.

3.2.3 Hydrostatic Pressure Logging

This method utilizes a pressure transducer run on wireline where the difference between pressure readings as the tool travels produces a fluid gradient which may then be converted to fluid density. This method has consisted of taking pressure measurements at discrete intervals; however, with the advent of gamma ray depth control, the tool must be run continuously. The resulting log must show fluid density, fluid gradient, or percentage cement. The requirements for hydrostatic pressure logging are as follows:

Subsection 3.2.2, items (a), (c), (d), (e), (f), (g), (h) apply.

(b) Pressure transducers must be calibrated in accordance with section 11.110 of the Oil and Gas Conservation Regulations.

3.2.4 Radioactive Tracer Logging

This method utilizes a radioactive tracer introduced into the lead slurry and the plug top is located by detection of the tracer with a gamma ray logging tool. Since the radioactive logging method is only locating the radioactive tracer, adequate precautions must be taken to properly mix the tracer with the cement, and to prevent channelling of the cement during pumping and displacement. It is recommended that a spacer fluid be used ahead of the cement to aid prevention of channelling with the drilling fluid. The resulting log must show the location of the tracer which is then interpreted as the plug top. The requirements for radioactive tracer logging are as follows:

Subsection 3.2.2, items (a), (b), (f) do not apply to this method.

Subsection 3.2.2, items (c), (d), (e), (g), (h) apply.

3.3 Suspend Drilling

- Suspend drilling refers to the premature suspension of operations prior to finishing the hole. It does not refer to normal rig release.
- The well must be in a safe and static condition before rig is removed.
- Where casing has not yet been set, appropriate open-hole cement plugs must be run before moving the rig off the well.
- The licensee must complete the well or properly abandon it within 6 months of suspension, or an extended period of time not to exceed 12 months under special circumstances subject to ERCB approval.
- Licensees must conform to the requirements of Interim Directive ID 90-4 if the well is to remain suspended for a period greater than 1 year.

3.4 Resume Drilling

This application type is used where the licensee must resume drilling to fulfil its licence requirements after a previous suspension of drilling operations.

3.5 Other Drilling Operations

- Other open-hole drilling operations include re-abandonments (usually due to a leaking plug), deepenings, whipstocks, or sidetracks. The latter two are usually in conjunction with a plugback. Section 5.3 details the application requirements for these operations.
- A deepening does not include resumption of drilling operations to fulfil the well licence requirements. A well deepening always involves drilling deeper than the licensed total depth or drilling into a formation below the licensed terminating formation.
- Whipstocks include redrilling a well directionally to a new bottom-hole location or whipstocking to drill a horizontal hole.
- Wherever use of a service rig is contemplated for conducting any drilling operation, special application and approval are required.
- Sidetracks refer to redrilling a portion of hole for mechanical reasons such as sidetracking an unrecoverable fish. Approval to plugback and sidetrack around a fish must be obtained during normal office hours from the Calgary office, Drilling Section.

3.6 Cased-hole Abandonments

- Representatives of the Board authorize the proposed method of abandonment of the well, and when necessary, the proposed method to eliminate any surface gas or protect usable water zones in the area. Refer to Appendix II for typical abandonment schematics.

- The perforated or open-hole section zone in a well may be abandoned by

  (1) setting a bridge plug within 15 metres of the perforations or open-hole section, pressure testing to 7000 kPa for 10 minutes, and capping with 8 lineal metres of Class "G" cement, or

  (2) setting a cement retainer above the perforations or open-hole section and cement squeezing the perforations or open-hole section, pressure testing the retainer to 7000 kPa for 10 minutes, and capping with 8 lineal metres of Class "G" cement, or

  (3) setting a plug in a permanent packer, pressure testing the plug and packer to 7000 kPa for 10 minutes, and capping with 8 lineal metres of Class "G" cement, or

  (4) setting a cement plug across the perforations or open-hole section (minimum 15 metres cement above and below completed interval). The plug must then be located by any method in Subsection 3.2, and the casing and plug pressure tested to 7000 kPa for 10 minutes.

- Non-perforated wells must have the existing casing string pressure tested to 7000 kPa for 10 minutes.

- After the completed interval is abandoned, the wellbore must be circulated to a corrosion-inhibited fluid. Weighted inhibitors may be used if the well does not have tubing.

- Where the intermediate or production casing is not cemented to surface, the licensee may be required to perforate the well and conduct remedial cementing operations in order to protect usable water zones in the area.

- Surface casing vent flows must be shut off at their point of origin prior to conducting the surface abandonment. The proposed remedial program must be approved by representatives of the Board. It should be noted that the ERCB's policy on surface casing vent flows is presently under review with industry.

- Surface abandonment shall consist of cutting the casing strings off a minimum of 1 metre below ground level. The production or intermediate casing shall be plugged at surface with a minimum five-sack cement plug and a steel plate shall be welded across the surface casing.

- For cased wells in oil sands areas refer to Subsection 4.2 of this guide.

3.7 Abandon-a-Zone/Temporary Abandon-a-Zone

- Board approval to abandon a zone is no longer required. However, should a licensee abandon a zone using a method that does not meet the minimum ERCB standards as outlined below, the licensee, prior to abandoning the well, will be required to conduct remedial measures to bring the zonal abandonment up to ERCB standards. Previous zonal abandonments not meeting these requirements but conducted with ERCB approval are satisfactory.

- The perforated or open-hole section zone in a well may be abandoned by

  (1) setting a bridge plug in casing within 15 metres of the perforations or open-hole section, pressure testing to 7000 kPa for 10 minutes, and capping with 8 lineal metres of Class "G" cement, or

  (2) setting a cement retainer above the perforations or open-hole section and cement squeezing the perforations or open-hole section, pressure testing the retainer to 7000 kPa for 10 minutes, and capping with 8 lineal metres of Class "G" cement, or

  (3) setting a plug in a permanent packer, pressure testing the plug and packer to 7000 kPa for 10 minutes, and capping with 8 lineal metres of Class "G" cement, or

  (4) setting a cement plug across the perforations or open-hole section (minimum 15 metres cement above and below completed interval). The plug must then be located by any method in Subsection 3.2, and the casing and plug pressure tested to 7000 kPa for 10 minutes.

- When depth limitations affect recompletion, 3 metres of a resin base/low permeability cement may be run in lieu of 8 metres of Class "G" cement.

- A wireline dump bailer may be used to place the cement or the resin base/low permeability cement in the well.

- Separate zones must be individually abandoned.

- When conducting a zonal abandonment in an oil sands area refer to Subsection 4.2 for minimum requirements.

3.8 Re-entries of Previously Abandoned Wells

- Operators re-entering an abandoned well **NOT** licensed to them must apply for a new well licence as stated in section 17 of the Oil and Gas Conservation Act.

- Operators re-entering an abandoned well presently licensed to them shall apply for approval on Board Form ED-21.

- All re-entries will require that the operator pressure test the casing after drilling out the surface plug and will also require that a casing inspection log be run on the casing prior to putting the well on production or injection if the casing is to be used for production or injection purposes. This log must be of the type which will determine remaining wall thickness and evaluate external and internal casing corrosion.

4 SPECIAL ABANDONMENTS

4.1 Casing Recovery

- Abandonments of this type may take longer to obtain approval since the Board must check to ensure that the casing is not needed for tertiary recovery in the area of the well.

- Any perforated or open-hole intervals shall be abandoned in accordance with Subsection 3.1 or 3.6 prior to cutting or shooting the casing.

- A maximum of 100 metres of casing is to be pulled before the plug is set across the stub. Alternatively, a bridge plug may be set 15 metres below the intended cut point and pressure tested, prior to cutting and pulling the casing.

- A cement plug must be set from at least 15 metres into the stub to a minimum of 15 metres out of the stub.

- The balance of open-hole section must be plugged in accordance with open-hole abandonment procedures as outlined in Section 3 of this guide.

- If the casing is unsuccessfully severed, a cement plug of not less than 30 metres must be placed across the intended cut point.

4.2 Oil Sands Areas

4.2.1 Cased Wells Completed in Oil Sands Zones

The licensee must identify the oil sands zones penetrated by the well. If this cannot be done from logs, then the maps in "Crude Bitumen Reserves Report, ERCB ST 8-38" should be used to determine which zones are potential oil sands zones in the area of the well. Minimum abandonment requirements are listed as follows:

Single Oil Sands Zone—Completed Wells

(1) A bridge plug shall be set in casing within 15 metres of the perforations or open-hole section and pressure tested to 7000 kPa for 10 minutes. A minimum 8-lineal-metre thermal cement plug must be placed on the bridge plug. The top of the plug must extend to at least 15 metres above the formation top, or

(2) A cement retainer shall be set within 15 metres of the perforations or open-hole section, and the perforations or open-hole section shall be cement squeezed and the retainer pressure tested to 7000 kPa for 10 minutes. When a deeper non-oil sands zone is to be completed the cement shall be drilled out and the squeezed perforations pressure tested to 7000 kPa for 10 minutes. A minimum 8-lineal-metre thermal cement plug must be placed on the retainer. The top of the plug must extend to at least 15 metres above the formation top, or

(3) A thermal cement plug shall be set across the formation (minimum 15 metres cement above the top of the formation and at least 15 metres below the formation or plugback TD, whichever is the lesser). The plug must then be located by any method in subsection 3.2, and the casing and plug pressure tested to 7000 kPa for 10 minutes.

Multi Oil Sands Zones—Completed Wells

(1) In a well where only the one oil sands zone is completed, the zone should be abandoned as outlined in (1) to (3) above.

(2) All non-completed oil sands zones must have a thermal cement plug run across the formation (minimum 15 metres cement above the top of the formation and at least 15 metres below the formation or plugback TD, whichever is the lesser). Note this plug may be combined into a longer plug to cover two or more zones.

Surface Abandonment—Oil Sands Areas

(1) After the completed interval is abandoned, the wellbore must be circulated to a corrosion-inhibited fluid. Weighted inhibitors may be used if the well does not have tubing.

(2) Where the intermediate or production casing is not cemented to surface, the licensee may be required to perforate the well and conduct remedial cementing operations in order to protect usable water zones in the area.

(3) Surface casing vent flows must be shut off at their point of origin prior to conducting the surface abandonment. The proposed remedial program must be approved by representatives of the Board.

(4) Surface abandonment shall consist of cutting the casing strings off a minimum of 1 metre below ground level. The production or intermediate casing shall be plugged at surface with a minimum five-sack cement plug and a steel plate shall be welded across the surface casing.

4.2.2 Open-hole Abandonments in Oil Sands Areas

- The licensee must identify the oil sands zones penetrated by the well. If this cannot be done from logs, then the maps in "Crude Bitumen Reserves Report, ERCB ST 8-38" should be used to determine which zones are potential oil sands zones in the area of the well.
- Thermal cement blends shall be used when abandoning wellbores which access or pass through oil sands or ERCB-designated heavy oil pools which are presently or have the potential to be engaged in heat-driven EOR projects.
- Thermal cement must be set a minimum of 15 metres above and below the oil sands or heavy oil formation that could be in heat-driven EOR projects.

- The remainder of the abandonment including the surface abandonment should be conducted as described under Subsection 3.1 of this guide.

4.3 Use of Bridge Plugs in Open-hole Abandonments

- The setting of a bridge plug inside surface casing is not permitted unless approval has been obtained from an ERCB office.

- In Southeastern Alberta, where the Milk River Formation is known to cause problems with leaking surface plugs, approval may be granted to set a bridge plug inside the surface casing provided that

  (1) a leak-off test has been conducted and the leak-off pressure at the shoe is at least 3100 kPa, and

  (2) there are no usable water zones or porous zones between the top of the Milk River and the surface casing shoe.

- A leak-off test is not required if the surface casing is set in the Milk River Formation; however, in that instance it must be ensured that there are no leaks outside the surface casing (suggested method: excavate around surface casing, fill with water, and check for bubbles).

- The above may be applied to any zone in any area; however, applications must include identification of the problem zone and its maximum pressure.

5 APPLICATION PROCEDURES

5.1 Open-hole Abandonments and Plugbacks

- Obtain verbal authorization from the appropriate area office.
- The area office will require log markers, porous and tight intervals, identification of any usable water zones, identification of oil sands zones, and drill-stem-test details.
- Wherever possible, a proposed plugging program should be given to area office staff during normal working hours.
- Once the authorization has been granted verbally, written confirmation will be mailed in the form of an ED-21 (white and yellow copies for abandonments, yellow copy for plugbacks). For abandonments, the summary report must be completed and resubmitted whereas the summary report for plugbacks is not required to be completed. Subsection 5.7 contains additional submission requirements for all drilling, completion, and abandonment operations. Refer to Appendix III for typical completed ED-21 forms.

5.2 Suspend or Resume Drilling

The operator must submit the ED-21 with the proposed program and the reason for the suspension or resumption of operations to the Drilling and Production Department's Drilling Section for review. A yellow copy of the ED-21 will be returned upon approval.

5.3 Other Drilling Operations

- An ED-21 application to deepen need be submitted only if the rig must be moved on the hole to deepen the well. Other applications to deepen where the rig is on the hole should be made by letter. The following must be addressed in all deepening applications:

  (1) mineral rights and H_2S release rate if entering a zone deeper than the licensed zone,

  (2) adequacy of casing in hole for well control (i.e. surface casing setting depth).

- Application to re-abandon an open hole, deepen, or whipstock should be made on Board Form ED-21 and submitted to the Drilling Section, Drilling and Production Department. Re-abandonments may also be submitted to the appropriate ERCB area office.
- Service rigs may be used to conduct drilling operations in limited circumstances and under special conditions. A letter of application, detailing surface equipment and nature of operation, is required.

- Applications to plugback and sidetrack for mechanical reasons such as an unrecoverable fish must be made during normal office hours to the ERCB head office, Drilling Section. An evaluation of the geology in the interval to remain uncemented is required.

- For all of the above approvals in this section, except re-abandonments, the yellow copy of the ED-21 will be returned upon approval. Re-abandonments will be handled as abandonments, see Subsection 5.1 of this guide.

5.4 Cased-hole Abandonments

- The ERCB requires all casing details, perforation details, cementing details, vent blow details (if applicable), drilling licence information, and the identification of any usable water zones or oil sands zones.

- A proposed abandonment program must be submitted on the ED-21 form for the ERCB's review. The ERCB will consider verbal programs in extenuating circumstances.

- Once the ED-21 has been authorized by the ERCB, written confirmation will be mailed in the form of the white and yellow copies of the ED-21 form. Once the abandonment work has been completed the summary report must be completed, the surface abandonment confirmed, the ED-21 form signed by a representative of the licensee and resubmitted to the ERCB for final approval. The ERCB will then return the yellow copy to the licensee for record purposes. Refer to Appendix III for typical completed ED-21 forms.

5.5 Abandon-a-Zone/Temporary Abandon-a-Zone (Cased Hole)

- ERCB approval is not required for these operations; however, the licensee must ensure that the work meets or exceeds the minimum requirements as set out in Subsection 3.7 of this guide.

- The licensee is required to submit copies of the workover reports to the ERCB Well Records Section.

5.6 Re-entries of Previously Abandoned Wells

- The operator completes the ED-21 only if re-entering its own well. If the well to be re-entered is a cased hole where no new hole will be drilled, the application must be submitted to the Completions Section, Drilling and Production Department. If the well to be re-entered is an open hole, or a cased hole to be deepened or whipstocked, the application must be submitted to the Drilling Section, Drilling and Production Department.

- If the operator is not the licensee of record, then a Well Licence application is required.

- All ED-21 applications must contain the following information:
  (1) details of surface lease
  (2) details of mineral lease
  (3) sour gas release rate submission in accordance with Interim Directive ID 87-2 or ID 90-1 as applicable
  (4) new survey plats (updated)
- The yellow copy of the ED-21 will be returned upon approval.
- All well licence applications for re-entry of an abandoned well must contain the information required by ERCB Guide G-33.

5.7 Additional Submission Requirements

In accordance with section 12.010 and Schedule 3 of the Oil and Gas Conservation Regulations and as restipulated in Informational Letter IL 87-7, licensees must submit prompt, concise, and complete reports of drilling, completion, and abandonment operations to the Calgary office of the ERCB.

APPENDIX I

REPORTING REQUIREMENTS FOR PLUG LOGGING OPEN-HOLE ABANDONMENTS

It is the licensee's responsibility to ensure that all of the reporting requirements for open-hole abandonments are met. Although some of the information required is obtained from third parties on the well site, (for example, the slurry volume), it is in the licensee's best interest to ensure the information is accurate. As an example, an erroneous cement slurry volume can lead to the interpretation of a significantly high plug.

For all plugs located with one of the plug logging methods the following information is required to be submitted either on the plug log attached to the ED-21 or on the abandonment summary report of Board Form ED-21:

(1) Mud density and bit size.

(2) Interval to be cemented.

(3) Drill pipe setting depth. (The strap tally and adjustments, used in conjunction with the collar locator, should be shown on the drilling tour reports to support the drill pipe setting depth.)

(4) Mass in tonnes and volume in cubic metres of cement that was run during placement of the plug. (This includes the calculated volume plus any excess run.)

(5) Type/class of cement used including any additives and the average slurry density.

(6) Volume of displacement fluid used.

(7) Plug placement time and logging time.

(8) Interval logged.

(9) Depth at which the cement top was logged.

(10) Quality of cement samples. (This is a visual analysis usually conducted by the cementing company which consists of time required for samples to set at surface.)

(11) Calibration: for direct density method, a calibration run must be shown on each log; for hydrostatic pressure method, the serial number, range, and date of last calibration of the gauges must be shown on the plug log; there are no calibration requirements for the radioactive tracer method.

(12) Depth control: a trace of the base correlation log must be shown on the plug log, or, remarks regarding all gamma ray deflections which were visually correlated and any depth corrections made must be included on the plug log.

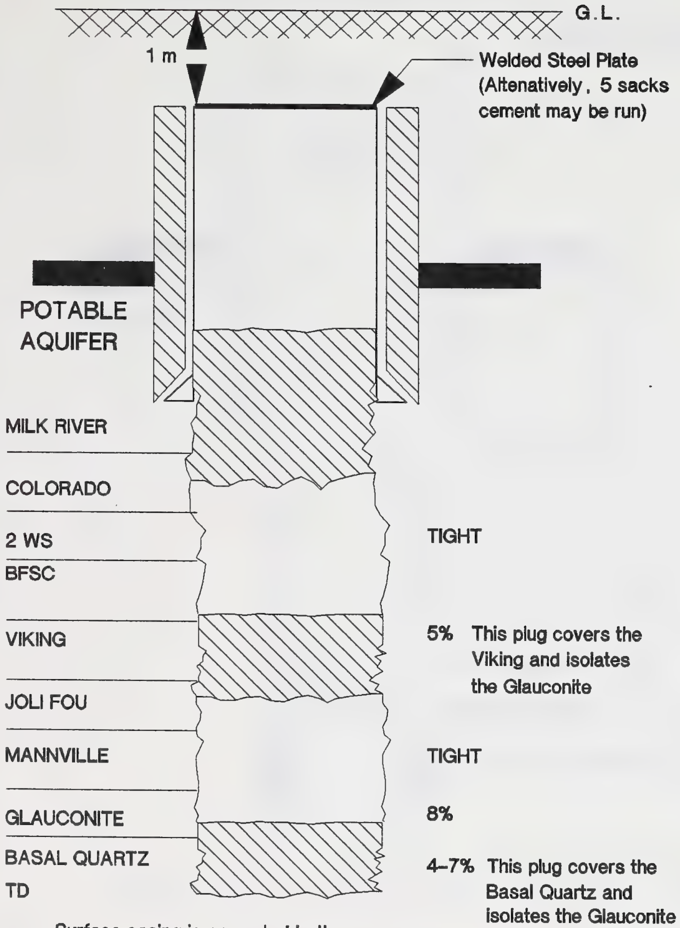
(13) Remarks concerning low cement plugs, rerun plugs, and any problems. Where a low or misrun plug was approved by a Board representative, a statement to this effect must be included.

Two copies of the resulting plug log must be submitted. One copy must be attached to Board Form ED-21 as part of the abandonment summary report. The second copy may be submitted separately to the attention of the Drilling Section, Drilling and Production Department, no more than 2 weeks after the abandonment is complete.

APPENDIX II

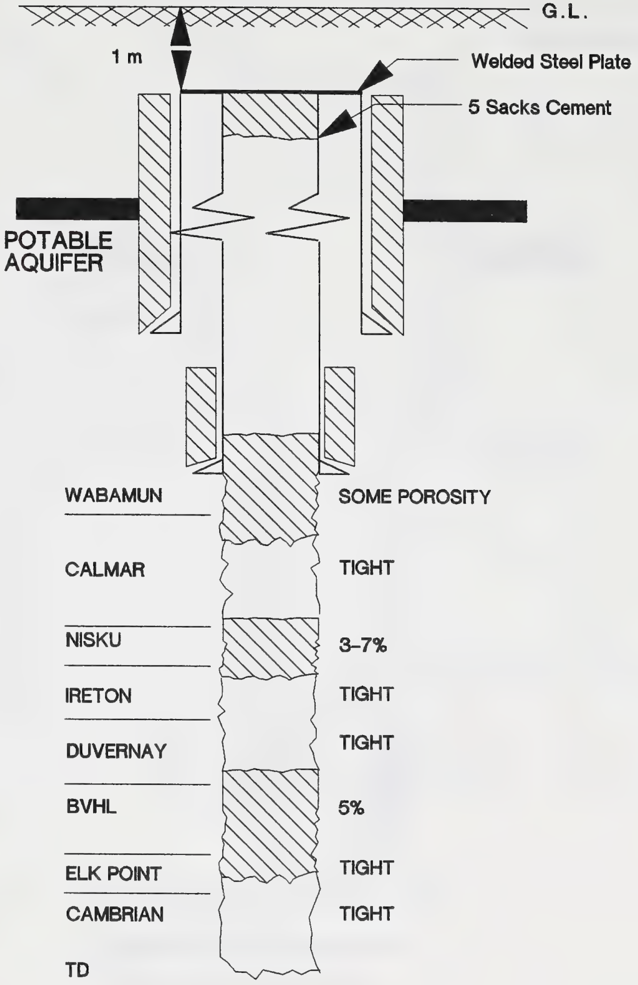
EXAMPLE ABANDONMENT SCHEMATICS

OPEN HOLE
NORMAL ABANDONMENT



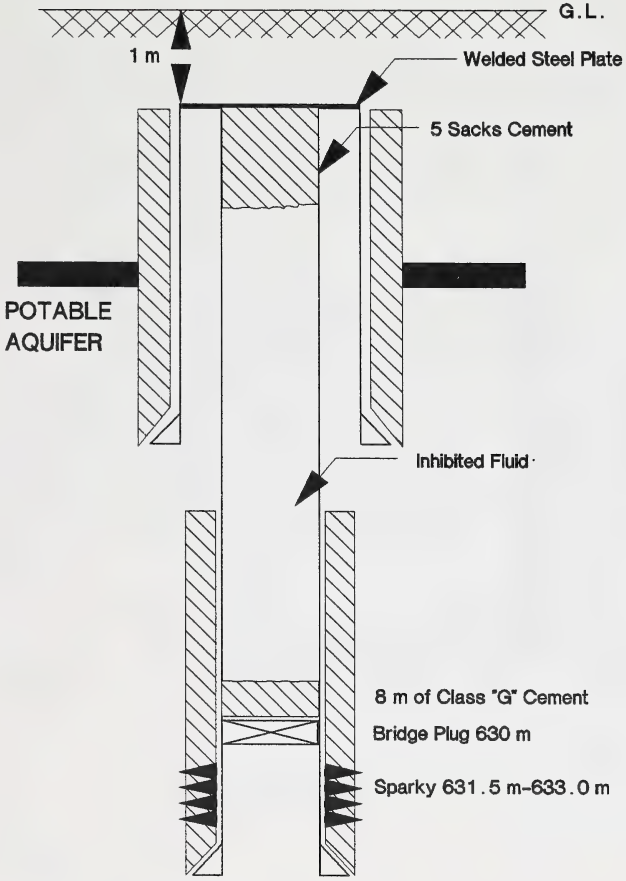
- Surface casing is cemented to the surface

OPEN HOLE
NORMAL ABANDONMENT



CASED HOLE

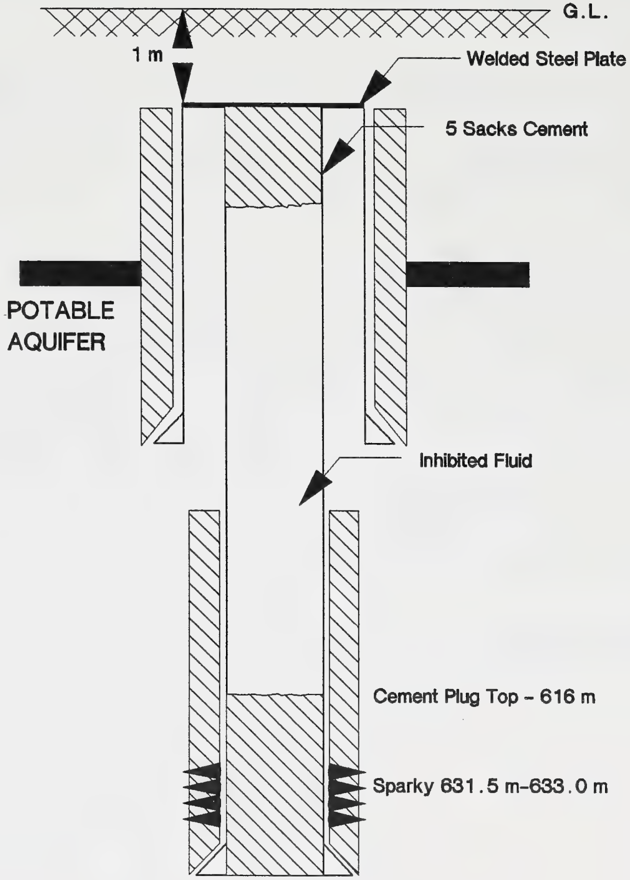
NORMAL ABANDONMENT



- Surface casing is cemented to the surface
- Production casing is cemented above all hydrocarbon-bearing zones

CASED HOLE

NORMAL ABANDONMENT



- Surface casing is cemented to the surface
- Production casing is cemented above all hydrocarbon-bearing zones

APPENDIX III

SAMPLES OF BOARD FORM ED-21

EXAMPLE OF CASED-HOLE ABANDONMENT

ERCB Energy Resources Conservation Board
640 Fifth Avenue SW
Calgary, Alta T2P 3G4

See instructions on reverse side.

☒ APPLICATION TO :
☒ APPROVAL TO :

☒ ABANDON A WELL ☐ PLUG BACK A WELL ☐ RE-ENTER A WELL ☐ DEEPEN A WELL ☐ RESUME DRILLING ☐ SUSPEND DRILLING ☐ REPAIR A SURFACE CASING VENT BLOW ☐ ____

ERCB CODE USE

Well Name	Unique Well Identifier	Licence Number	ERCB Area Office	Company Representative	Phone
TEC ET AL LACOMBE 13-13-41-27	LE 02 LS 13 SC 13 TWP 041 RG 27 W M 4 E 0	0150001	RED DEER	T. COOK	999-4487

Log Markers	Depth (m)	Porous or Perf. Intervals (m)
DEEPEST USABLE AQUIFERS *	263.0	
Nisku		1781.0 – 1784.5
		1785.0 – 1791.5

Data	Depth (m)	Casing Size (mm)	Hole Size (mm)
KB	721.5		
Casing SFC	215.0	244.5	
Inter			
Prod	1805.0	177.8	
Total Depth	1805.0	PBTD	

Program of Operations

1. Set BP at 1775 m.
2. Pressure test BP to 14 000 kPa for 10 minutes.
3. Cap BP with 8 m Class G cement.
4. Circulate wellbore to inhibited fluid.
5. Perforate casing string 15 m below base of aquifer and recement production casing to surface. Pressure test perfs to 7000 kPa for 10 minutes.
6. Abandon at surface as per condition 3.

*SEE REVERSE SIDE

FOR CASED WELL ABANDONMENTS

	YES	NO
DOES THE WELL HAVE A SURFACE CASING VENT BLOW	☐	☒
IS THE INTER/PROD. CASING CEMENTED TO SURFACE	☐	☒

IF NO, ESTIMATE CMT. TOP ____ mKb LOGGED 415 mKb

ERCB Authorized Abandonment Program

Plug No. ____ and ____ May Be Staged Stage Felt

Cement Plug	Interval (m)		Feel After 8 hours
1	To		
2	To		
3	To		
4	To		
5	To		
6	To		
7	To		
8	To		

Conditions for this program as described on the reverse side as follows:
No.(s) 1, 3, & 8

Program Authorization

On YR 91 MO 01 DY 02
By D. Opinko
Name (Typed)
D. Opinko
Signature
Calgary, Drilling & Production
Office

Program Approval

On YR __ MO __ DY __
By ____

Summary Report of Abandonment Program Followed

Volume of Cement and Additives	Bottom of Pipe Set at (m)	Plug Felt–(If logged, attach logs) Depth (m)	Mass(daN)	Date	Time
Set bridge plug at 1775 m, pressure tested bridge plug to 14 mPa					
for 15 minutes capped with 8 m cement.					
Perforated production casing from 278 – 278.5 m, established					
circulation to surface. Circulated cement back to surface.					
Pressure tested perfs and casing to 7 mPa for 10 minutes – held.					

Was either condition 2 or 3 (described on reverse side) completed? ☒ Yes ☐ No

Reason for Abandonment

☒ It is no longer commercially productive of oil or gas.
☐ Testing and logging failed to disclose evidence of commercially recoverable hydrocarbons.
☐ It was necessary to abandon for safety or mechanical reasons.
☐ PNG Expiry Number ____

Certification

☒ The Licensee(Agent) hereby certifies that the abandonment was carried out for the reason(s) indicated and in accordance with the program authorized by the ERCB as shown in the summary report.
☐ The Licensee(Agent) hereby certifies that the program of operations will be carried out for the reason(s) indicated.

Signature ____ Title President
Date 17 January 1991

Company TEC Industries
Address 640 – 5 Avenue SW
Calgary, AB T2P 3G4

ED 21 91-01

EXAMPLE OF CASED-HOLE ABANDONMENT

See instructions on reverse side.

ERCB Energy Resources Conservation Board
640 Fifth Avenue SW
Calgary, Alta T2P 3G4

☒ APPLICATION TO :
☒ APPROVAL TO :

☒ ABANDON A WELL ☐ RE-ENTER A WELL ☐ RESUME DRILLING ☐ REPAIR A SURFACE CASING VENT BLOW
☐ PLUG BACK A WELL ☐ DEEPEN A WELL ☐ SUSPEND DRILLING ☐ ______

ERCB CODE USE

Well Name	Unique Well Identifier	Licence Number	ERCB Area Office	Company Representative	Phone
TEC ET AL WAINWRIGHT 1B-1-45-5	LE 00 LS 01 SC 01 TWP 045 RG 05 W M 4 E 0	0100000	WAINWRIGHT	T. COOK	999-4991

Log Markers	Depth (m)	Porous or Perf. Intervals (m)
DEEPEST USABLE AQUIFERS *	118.5	
Sparky		621.0 - 623.5

Data	Depth (m)	Casing Size (mm)	Hole Size (mm)
KB	631.0		
Casing SFC	131.0		
Inter			
Prod	681.5		
Total Depth	682.0	PBTD	640.0

Program of Operations

1. Set bridge plug at 620 m.
2. Pressure test bridge plug to 7000 kPa for 10 minutes.
3. Cap bridge plug with 8 m cement.
4. Circulate well to inhibited fluid.
5. Abandon at surface as per condition 3.

*SEE REVERSE SIDE

FOR CASED WELL ABANDONMENTS

	YES	NO
DOES THE WELL HAVE A SURFACE CASING VENT BLOW	☐	☒
IS THE INTER/PROD. CASING CEMENTED TO SURFACE	☒	☐

IF NO, ESTIMATE CMT. TOP ______ mKb LOGGED ______ mKb

ERCB Authorized Abandonment Program

Plug No. ______ May Be Staged and ______ Stage Felt

Cement Plug	Interval (m)		Feel After 8 hours
1		To	
2		To	
3		To	
4		To	
5		To	
6		To	
7		To	
8		To	

Conditions for this program as described on the reverse side as follows:
No.(s) 1, 3, 8 & 9

Program Authorization

On YR 91 MO 01 DY 01

By B. M cFarlane
Name (Typed)

B M cFarlane
Signature

Calgary, Drilling and Production
Office

Program Approval

On YR ___ MO ___ DY ___

By ______

Summary Report of Abandonment Program Followed

Volume of Cement and Additives	Bottom of Pipe Set at (m)	Plug Felt–(If logged, attach logs) Depth (m)	Mass(daN)	Date	Time
- Set bridge plug at 618 m					
- pressure tested to 7000 kPa for 10 minutes					
- capped with 8 m Class G cement					
- circulated well to inhibited fluid					
- surface abandonment checked by Wainwright office					

Was either condition 2 or 3 (described on reverse side) completed? ☒ Yes ☐ No

Reason for Abandonment

☒ It is no longer commercially productive of oil or gas.
☐ Testing and logging failed to disclose evidence of commercially recoverable hydrocarbons.
☐ It was necessary to abandon for safety or mechanical reasons.
☐ PNG Expiry Number ______

Certification

☒ The Licensee(Agent) hereby certifies that the abandonment was carried out for the reason(s) indicated and in accordance with the program authorized by the ERCB as shown in the summary report.

☐ The Licensee(Agent) hereby certifies that the program of operations will be carried out for the reason(s) indicated.

Signature ______ Title President

Date 15 January 1991

Company TEC Industries Limited
Address 640 - 5 Avenue SW
Calgary, AB T2P 3G4

ED 21 91-01

EXAMPLE OPEN-HOLE ABANDONMENT

See instructions on reverse side.

ERCB
Energy Resources Conservation Board
640 Fifth Avenue SW
Calgary, Alta. T2P 3G4

☐ APPLICATION TO : ☒ ABANDON A WELL ☐ RE-ENTER A WELL ☐ RESUME DRILLING ☐ REPAIR A SURFACE CASING VENT BLOW
☒ APPROVAL TO : ☐ PLUG BACK A WELL ☐ DEEPEN A WELL ☐ SUSPEND DRILLING ☐

ERCB CODE USE

Well Name	Unique Well Identifier	Licence Number	ERCB Area Office	Company Representative	Phone
ABC OKOTOKS 1-1-21-28	LE 00 LS 01 SC 01 TWP 021 RG 28 W M 4 E 0	1111000	CALGARY SOUTH	JOE SMITH	555-5555

Log Markers	Depth (m)	Porous or Perf. Intervals (m)
DEEPEST USABLE AQUIFERS *		
Completed by ERCB-obtained from		
licensee representative over the phone.		
No aquifers below 300 m.		
BR	900	tight
Lea Park	1200	tight
Colorado	1300	tight
2nd W.S.	1650	tight
BFSC	1800	tight
Viking	1810	1823 - 1842
Mann	1900	5%
Rierdon	2100	tight
Elkton	2110	tight
Shunda	2200	tight
Pekisko	2210	6%
Banff	2300	tight
Exshaw	2500	tight
Wabamun	2550	2565-2570
Crossfield	2575	2580-2591

*SEE REVERSE SIDE

FOR CASED WELL ABANDONMENTS

	YES	NO
DOES THE WELL HAVE A SURFACE CASING VENT BLOW	☐	☐
IS THE INTER/PROD. CASING CEMENTED TO SURFACE	☐	☐

IF NO, ESTIMATE CMT. TOP ______ mKb LOGGED ______ mKb

Data	Depth (m)	Casing Size (mm)	Hole Size (mm)
KB	1042.7		
Casing SFC	300	244.5	
Inter			
Prod			
Total Depth	2600	PBTD	

Program of Operations

DST #2 2575-2590 recov.

200 m gas cut mud.

Plug No. 3 may be staged at 1950 m.

ERCB Authorized Abandonment Program

Plug No. 3 May Be Staged and 2 Stage Felt

Cement Plug	Interval (m)			Feel After 8 hours
1	2600	To	2535	No
2	2315	To	2185	Yes
3	2115	To	1808	Yes
4	315	To	285	Yes
5		To		
6		To		
7		To		
8		To		

Conditions for this program as described on the reverse side as follows:
No.(s) 7 plugs 2, 3, 4
2

Program Authorization

On YR 90 MO 02 DY 28

By S. Baron
Name (Typed)

Signature
Calgary South
Office

Program Approval

On YR MO DY

By ______

Summary Report of Abandonment Program Followed

Volume of Cement and Additives	Bottom of Pipe Set at (m)	Plug Felt–(If logged, attach logs) Depth (m)	Plug Felt Mass(daN)	Plug Felt Date	Plug Felt Time
$4t(3m^3)$ 0:1:0	2598	No feel	required		
$6t(4.6m^3)$ 0:1:0	2314	2179	logged		
$7t(5.3m^3)$ 0:1:0	2115				
$6t(4.6m^3)$ 0:1:0	1950	1800	logged		
$1.5t(1m^3)$ 0:1:0	315	250	logged		
See attached plug log for additional details.					

Was either condition 2 or 3 (described on reverse side) completed? ☒ Yes ☐ No

Reason for Abandonment

☐ It is no longer commercially productive of oil or gas.
☒ Testing and logging failed to disclose evidence of commercially recoverable hydrocarbons.
☐ It was necessary to abandon for safety or mechanical reasons.
☐ PNG Expiry Number ______

Certification

☒ The Licensee(Agent) hereby certifies that the abandonment was carried out for the reason(s) indicated and in accordance with the program authorized by the ERCB as shown in the summary report.
☐ The Licensee(Agent) hereby certifies that the program of operations will be carried out for the reason(s) indicated.

Signature
Drilling Supervisor
Title
90-03-12
Date

Company Address
ABC OIL & GAS LTD.
111 - 1 Avenue SW
Calgary, AB T3A 1A1

ED 21 91-01 LEFT HAND SIDE OF FORM IS COMPLETED BY ERCB.

▨ SHADED AREAS MUST BE COMPLETED BY LICENSEE/AGENT AND RE-SUBMITTED

EXAMPLE OF OTHER DRILLING OPERATIONS

ERCB Energy Resources Conservation Board
640 Fifth Avenue SW
Calgary, Alta T2P 3G4

See instructions on reverse side.

☒ APPLICATION TO :
☒ APPROVAL TO :

☐ ABANDON A WELL
☐ PLUG BACK A WELL
☐ RE-ENTER A WELL
☒ DEEPEN A WELL
☐ RESUME DRILLING
☐ SUSPEND DRILLING
☐ REPAIR A SURFACE CASING VENT BLOW
☐ ______

ERCB CODE USE

Well Name: ABC SYLAKE 1-1-38-2

Unique Well Identifier:

LE	LS	SC	TWP	RG		M	E
0 0	0 1	0 1	0 3 8	0 2	W	5	0

Licence Number: 2 2 2 2 1 1 1

ERCB Area Office: RED DEER

Company Representative: JOE SMITH

Phone: 555-5555

Log Markers	Depth (m)	Porous or Perf. Intervals (m)
DEEPEST USABLE AQUIFERS *		
BFSC	1870	
Viking	1890	1892 - 1897
TD	1900	

Data	Depth (m)	Casing Size (mm)	Hole Size (mm)
KB	990.2		
Casing SFC	250	244.5	
Inter			
Prod	1898	178.9	
Total Depth	1900	PBTD	

Program of Operations

(Note: New casing set at 1898, 90/01, cemented to 100 m above the Belly River)

To use a drilling rig.

Rig up. Drill out production shoe to 1912. Leave as open-hole completion in the Viking.

* SEE REVERSE SIDE

FOR CASED WELL ABANDONMENTS

	YES	NO
DOES THE WELL HAVE A SURFACE CASING VENT BLOW	☐	☐
IS THE INTER/PROD. CASING CEMENTED TO SURFACE	☐	☐

IF NO, ESTIMATE CMT. TOP ______ mKb LOGGED ______ mKb

ERCB Authorized Abandonment Program

Plug No. ______ May Be Staged and ______ Stage Felt

Cement Plug	Interval (m)		Feel After 8 hours
1	______	To ______	______
2	______	To ______	______
3	______	To ______	______
4	______	To ______	______
5	______	To ______	______
6	______	To ______	______
7	______	To ______	______
8	______	To ______	______

Conditions for this program as described on the reverse side as follows:
No.(s) 1,8

Program Authorization

On YR 9 0 MO 0 2 DY 2 8

By S. Baron
Name (Typed)

Signature

Calgary, Drilling & Production
Office

Program Approval

On YR ___ MO ___ DY ___

By ______

Summary Report of Abandonment Program Followed

Volume of Cement and Additives	Bottom of Pipe Set at (m)	Plug Felt–(If logged, attach logs)			
		Depth (m)	Mass(daN)	Date	Time

Was either condition 2 or 3 (described on reverse side) completed? ☐ Yes ☐ No

Reason for Abandonment

☐ It is no longer commercially productive of oil or gas.
☐ Testing and logging failed to disclose evidence of commercially recoverable hydrocarbons.
☐ It was necessary to abandon for safety or mechanical reasons.
☐ PNG Expiry Number ______

Certification

☐ The Licensee(Agent) hereby certifies that the abandonment was carried out for the reason(s) indicated and in accordance with the program authorized by the ERCB as shown in the summary report.

☒ The Licensee(Agent) hereby certifies that the program of operations will be carried out for the reason(s) indicated.

Signature ______ Title: Drilling Supervisor

Date: 90-01-15

Company Address: ABC OIL & GAS LTD.
111 - 1 Avenue SW
Calgary, AB T3A 1A1

ED 21 91-01

FORM IS FILLED OUT BY LICENSEE/AGENT. ▨ SHADED AREAS ARE COMPLETED BY THE ERCB.